The Meteorological Magazine

Air Ministry :: Meteorological Office

Vol. 57
Mar. 1922
No. 674

LONDON : PUBLISHED BY HIS MAJESTY'S STATIONERY OFFICE.

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Land- and Sea-Breezes in the Gulf of Lions.

By Professor M. MOYE.

LAND-BREEZES and sea-breezes are a distinctive feature of the summer climate of the French and Catalonian coasts of the Mediterranean Sea. They are much more marked here than on the Channel or Atlantic shores where they are often masked by the general circulation of the atmosphere. In the Mediterranean Sea, surface winds are normally light and variable in summer, and local convection currents are readily set up.

Land- and sea-breezes are well known in general terms, but much scope remains for detailed studies. It appears, therefore, to be of some interest to give a short *résumé* of our own observations at Montpellier (France) and especially of a complete investigation* planned and carried out by Prof. E. Fontséré of the Faculty of Sciences of Barcelona, Director of the Aeronautical Station.

Sea-breezes begin at Barcelona in March, blowing on about four days out of ten. In April and May, they blow on more than six days out of ten. From July 15th to August 15th sea-breezes are recorded on nine days out of ten. They slowly decrease in frequency in September and practically disappear by the end of October. At Montpellier, local shore-winds are much less frequent. They are rare before mid-May and after

* *Sobre els vents estivals de Conveccio a la Costa Catalana.*—Barcelona, 1918. (*See* Reviews in *Meteorological Magazine*, September, 1919, p. 92, and in *Meteorological Office Circular*, No. 34, p. 4.)

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September. But in both stations their frequency varies with the summer temperature. At Barcelona as at Montpellier, the direction of sea-breezes is almost always from south or south-south-west. It should be noted that the direction is rather tangential to the Catalonian coast, but perpendicular to that of France. The winds are probably caused by convection currents, not only in a restricted area close to the sea, but also over a large area inland.

Sea-breezes begin, as a rule, after a short period of calm and are followed by another calm of longer duration. In the night and early morning, land-breezes blow gently, but not from an opposite direction. In fact, both land- and sea-breezes are slowly rotating with the apparent motion of the sun, or, to use the usual term, veering. Backing, or rotation from south to north by east is not unknown, but is much less frequent than veering, giving only 20 per cent. of the possible cases at Barcelona.

Sea-breeze, beginning from a south or south-west direction, comes from south-west or west-south-west in the afternoon. Evening or night land-breezes blow from north-west or north, but this direction is not quite stable and, often, it varies at random until the morning. Our observations at Montpellier are in perfect agreement with those of Professor Fontséré.

The hours of beginning and ending are of special interest. Professor Fontséré has collected and put in order many observations from 31 stations, both on the coast and inland. In mid-summer, the sea-breeze rises about 8 a.m. almost simultaneously all along the coast. Then it spreads in opposite directions, seawards and landwards, always blowing from the same quarter, the affected area increasing in width at a rate of about 8 miles per hour. At mid-day the sea-breeze, travelling inland, has reached its furthest extension, about 25 to 30 miles from the shore. In the meantime, its velocity keeps steadily increasing, the maximum coming at 2 p.m. on the coast and 5 p.m. inland. The end is quite abrupt, taking place sharply at 6 p.m. over the whole area, marine and continental.

Sea-breezes blow, as a rule, more strongly than land-breezes, with occasional exceptions and subject to the influence of the general distribution of pressure. When the barometric gradient is favourable to wind from the north-western quadrant, a common phenomenon on the Mediterranean coasts, it is clear that sea-breeze is in opposition and remains quite light. In fact, at Montpellier, with a light wind from north-west in the morning, the only effect analogous to the sea-breeze is a dead calm in the afternoon, with a sultry and close atmosphere.

The force of a normal sea-breeze as registered by the anemograph at the Barcelona station corresponds with 4 or 5 on the Beaufort scale. At Montpellier, the breeze is rather lighter, not exceeding force 3 or 4, the maximum velocity being reached, as indicated above, between 3 and 5 p.m. Land-breezes are always very light, often falling almost to a calm. They are also irregular in the small hours of the night, blowing by little puffs from any part of the horizon. At sunrise, the land-breeze increases somewhat, before the calm, just before the coming of the sea-breeze.

Land- and sea-breezes are essentially surface currents. It follows they must be supplemented by a return circulation in high atmosphere.

Professor Fontséré tested these points by ascents of pilot balloons. His results are that sea-breezes begin at a very moderate height, 300 or 400 feet only, the superior limit rises steadily and reaches 3,000 to 4,000 feet in early afternoon. On the French coast this height is rather less, about 2,000 feet at Toulon.

Above the sea-breeze there is a layer of calm which has a depth of 700 to 800 feet. Above this layer flows the return circulation, which may reach up to 10,000 feet, when it is lost in the general circulation of the upper atmosphere. The direction of the return circulation is not diametrically opposed to the surface current. It blows from points between south-west and north, varying day by day, with a notable predominance of the north-west quadrant. In the afternoon, the return circulation may slowly veer northwards, but there is always a component towards the sea. Indeed, this fact is a serious drawback to aerological soundings by ballons-sondes, the registering apparatus of which is very often lost at sea.

Sea-breezes do not cause, on the French or Catalonian coasts, the great changes of temperature which are so noticeable in tropical regions. The thermometer rises sharply in summer from 7 to 11 a.m. and then quite slowly until 2 or 3 p.m. The change in relative humidity is also moderate, as might be anticipated from the narrow band of sea swept by the coming breeze. In Catalonia, however, sea-breezes bring in shore clouds of the cumulus type which dissolve away in the late afternoon. At Montpellier it is only occasionally that the sea-breeze disturbs the clearness of the sky.

From a biological point of view, sea-breezes are very welcome, helping us to support a summer heat and making the afternoon often pleasanter than the morning or evening.

The British Rainfall Organization.

Removal of Headquarters to South Kensington.

READERS of the *Meteorological Magazine* are aware that on the retirement of Dr. H. R. Mill, in July 1919, the British Rainfall Organization was attached to the Meteorological Office, and has since that date been carried on as an integral part of the official meteorological service of the country. Up to the present time the work has been continued at the old headquarters at 62, Camden Square, London, N.W.1, the house around which so much of the history of the Organization has centred, but it is felt that the time has now come when co-operation with the other departments of the Office will be greatly facilitated by having the British Rainfall Organization in the building occupied by the Meteorological Office in Exhibition Road, South Kensington, and it is proposed to transfer the Offices of the Organization to that address on March 20th. The building in Exhibition Road, which was largely designed in 1910 by Sir Napier Shaw, was originally intended to house the whole of the Meteorological Office, but the absorption of the Office in the Air Ministry made it necessary recently to place some of the departments at the Air Ministry in Kingsway. The departments now occupying the Office at Exhibition Road are those dealing with Climatology and Instruments, so that the addition of the British Rainfall Organization work will be appropriate.

One of the matters which has given rise to some anxiety has been the possibility that it might be necessary to discontinue the old series of meteorological observations at Camden Square. These records were commenced by the late Mr. G. J. Symons in 1857, not as a matter of fact precisely in the same site as the station now occupies, but in the neighbouring garden of 136, Camden Road, about 250 yards to the south-west. The instruments were removed in 1869 to their present position.

The observations in 1857 were broken, but from January 5th, 1858, a complete daily series extends to the present day, comprising pressure, temperature, rainfall and other elements. From time to time other instruments have been added, the most important being a self-recording rain gauge, in 1881, and an evaporation tank in 1885. The records of rainfall duration and of evaporation are probably unique.

The house at 62, Camden Square, has remained the property of the Trustees, who remained in being for the purpose of administering the Endowment Fund, after the transfer of the responsibility for the work of the British Rainfall Organization to the Government. An arrangement has now been made by which the house and the other property of the Trust are

being handed over to the Royal Meteorological Society, who have undertaken to maintain the meteorological observations and to utilize the balance of the funds for the furtherance of rainfall observing and research. It is hoped by this arrangement that the continuity of the historic record has been secured, if not in perpetuity, at least so long as the site remains suitable for the purpose.

With regard to the rainfall work, all correspondence in future should be addressed to the Superintendent, British Rainfall Organization, Meteorological Office, Air Ministry, London, W.C.2. Rainfal returns may be addressed to the Superintendent, British Rainfall Organization, Meteorological Office, South Kensington, London S.W.7. For the present any communications sent to 62, Camden Square will be forwarded. The telegraphic address is "Meteorology Southkens, London," and the telephone number Kensington 5810. The Superintendent hopes that Observers or others interested in the work will continue the pleasant custom of calling at the Office in Exhibition Road when in town.

Meteorology and Art.

AN interesting communication has been received from Mr. D. E. Row, F.R.Met.Soc., on the application of meteorology to art.

The sky plays a large part in the composition of landscape or seascape not only as a detail of the picture but also because it determines the characteristic lighting of other details. Forecasts of sky types would therefore be of great use to artists desiring to paint certain effects. Mr. Row suggests that special forecasts might be issued to meet the requirements of artists, or that artists themselves should acquire facility in forecasting local weather from the official weather map. He points out, however, that prejudice is the greatest obstacle to the success of the plan, since, to the lay mind, meteorology is too inexact to be of practical use; moreover, artists have to be persuaded that it is worth while to supplement the weather wisdom gathered in their own experience by the information which the meteorologist obtains from his charts.

Mr. Row gives instances of his own success in forecasting sky-types by using the "Further Outlook" of the *Daily Weather Report* in conjunction with local signs. He finds, for example, that complicated systems of cirrus and cirro-cumulus occur in front of a depression, while the "composite" sky in which many types of cloud at different levels may be observed is associated with a more indefinite pressure distribution, as in a secondary depression. These two sky-types, moreover, are

found to be effective from the artist's point of view at sunset. But the artist's meteorology need not stop at "sky-type"; wind is of great value, for it is responsible for fine effects on trees and water as well as on the sky, while mist and haze add considerable beauty to almost any scene.

Mr. Row is to be congratulated on his success and it is to be hoped that his work will be extended. A classification of different effects of wind, cloudiness, sky coloration and so on, with the types of weather which precede them, would be very useful and the value to artists would be increased by references to examples from the Masters.

OFFICIAL NOTICES.

Meteorological Units.

As from the beginning of 1922 the partial use of the Absolute Scale of temperature in the *Weekly* and *Monthly Weather Reports* of the Meteorological Office is being given up. It will be remembered that the Absolute Scale was introduced tentatively in these Reports in 1916, the intention being to adopt it completely if the plan met with general approval.

It was anticipated that, with the development of interest in the upper air, the advantages of using an Absolute Scale of temperature for all meteorological work would become manifest; but the conservative spirit has been too strong (it is backed by some good arguments) and at present the Fahrenheit Scale is accepted even for aeronautical observations.

It has, therefore, been decided to revert to the exclusive use of the Fahrenheit Scale in the two reports of the Office intended for general use.

It is at present intended to keep to the Absolute Scale in the summaries of observations at the Observatories. There is no question of departing from it in the *Réseau Mondial.*

In the wind summaries in the *Weekly* and *Monthly Reports* it has been found possible to provide for the publication of corresponding figures in miles per hour and metres per second, so as to meet the needs of the layman as well as of the student of dynamical meteorology.

It should be added that it is considered that the millibar is now too well established for the presentation of alternative pressure units to be necessary. The practice of showing rainfall in both millimetres and inches is to continue.

Channel Forecasts.

By arrangement with Messrs. W. H. Smith and Sons, special copies of the *Daily Weather Report* have been put on sale at Victoria Station at the time of departure of the boat trains. The reports have stamped on the front page

in bold, red letters "Channel Forecasts Inside," and contain a special duplicated sheet giving the probable state of the crossings from Folkestone to Boulogne and from Dover to Ostend.

Staff News.

Dr. Harold Jeffreys has given up the position of librarian at the Meteorological Office, South Kensington, to return to Cambridge as a lecturer in Applied Mathematics. Dr. Jeffreys came to the Office in 1917, when he had already made a reputation by his researches in the Physics of the Globe. Amongst the meteorological papers which he has published in the Philosophical Magazine and elsewhere, the following may be mentioned:—"On periodic convection in the atmosphere" (two papers), "Some problems in evaporation," "On travelling atmospheric disturbances," "On the relation between wind and pressure distribution," "Tidal friction in shallow seas," "On turbulence in the ocean" and "On the dynamics of wind." The importance of such papers will be more fully realised when the much-to-be-desired treatise on the mechanics of the atmosphere, designed for students with adequate mathematical equipment, comes to be written.

Mr. Arthur Hope Bell, Principal Assistant in the Climatology Division, retired at the end of February after 45 years' service in the Meteorological Office. For many years Mr. Bell had been responsible for the preparation of the *Monthly Weather Report*, work in which his knowledge of the traditions of the Office, his powers as a computer and his conscientious attention to detail were invaluable. Mr. Bell become Principal Assistant on the retirement of Mr. A. R. Simpkins a year ago.

Official Publications.

A Short Course in Elementary Meteorology. By W. H. Pick. $9\frac{1}{2} \times 6$. pp. 118. 1921. 1s. 6d. net.

THE training of cadets at the Royal Air Force College at Cranwell includes a course in meteorology. Captain W. H. Pick, who is the lecturer in this subject, qualified as a practical meteorologist in the Meteorological Section of the Royal Engineers. He saw service in France during 1918, and in January 1919 he went to Murmansk in command of the detachment attached to the North Russian Expeditionary Force. The text-book which Captain Pick has written for his classes will, it is hoped, prove useful to other students.

Discussions at the Meteorological Office.

FEB. 20th, 1922. *Agricultural Meteorology.* By J. Warren Smith. (New York: Macmillan Co. 1920.) Opener—Mr. R. H. Hooker.

THE great variety of climate within the limits of the United States and the corresponding diversity in the crops, attract numerous workers to agricultural meteorology. Professor J. Warren Smith's book is of special value as a guide to the extensive literature on his subject. Mr. Hooker's principal criticism of the work was that the mass of detail made the more important chapters rather overwhelming for such a student as might be expected to consult the "Rural Textbook Series." With regard to the correlations which have been established for so many agricultural products between the amount of the crop and the weather at critical periods of growth, it was mentioned in the discussion that information as to the mean values of the elements involved is desirable. In fact, the regression equation is required as well as the correlation co-efficient. The activity of the Weather Bureau in providing special forecast for farmers is described in the concluding chapters. Forecasts of snow or rain are distributed in the West at shearing and lambing time. Rain forecasts are issued where grapes are being dried for raisins, to enable the growers to protect the drying trays. Frost warnings are issued "for truck-growers and orchardists."

MARCH 6th, 1922. *Atlas of Tracks of* 620 *Typhoons*, 1893–1918. By Louis Froc, S.J. (Zi-ka-wei Observatory, 1920.) Opener—Mr. L. C. W. Bonacina.

THE collection of charts shewing the recorded paths of the typhoons of the China Seas was prepared as an Appendix to a general discussion of the subject, but it has been issued alone as experience indicated that it was desirable to place the information at the disposal of navigators without further delay. A striking feature of the charts is the way in which the few storm-centres which reach the coast of China, fail to penetrate inland. The normal distribution of pressure for the period is indicated on each chart, but it is disconcerting to find many of the isobars forked. No explanation of what such isobars are intended to indicate is to be found in the text.

Mr. Bonacina shewed slides from the office collection to illustrate the localities subject to tropical cyclones in various parts of the globe and invited discussion on the question as to why the phenomena were so much localised. He called attention to the absence of cyclones in the South Atlantic.

The Royal Meteorological Society.

THE usual monthly meeting of this Society was held on Wednesday, February 15th, at 49, Cromwell Road, South Kensington; Dr. C. Chree, F.R.S., President, in the chair. Two papers were read.

C. E. P. Brooks, M.Sc., and J. Glasspoole, B.Sc.—The Drought of 1921. The general rainfall in England and Wales in 1921 was the least, so far as can be ascertained, since 1788. Individual long records indicated that over a considerable part of the south-east of England 1921 was the driest year for at least a century and a half. The months of 1921 were not individually so remarkable, as was shown by a comparison with the driest months known to have occurred in the British Isles generally. A special comparison was also made between periods of from three to nine months' duration in 1921 with that of similar dry periods in previous years. Reference was made to a map of standard deviation of annual rainfall, 1881–1915, for the British Isles, as indicative of the areas most liable to extreme dryness. During these dry years the least fluctuations of annual rainfall occurred along the coast in the north-west of the British Isles, increasing to a maximum in the south-east and centre of the land-masses. The second half of the paper dealt with the causes of drought conditions over the British Isles. The problem was attacked by constructing charts showing the distribution of barometric pressure over the globe during and preceding each of the great droughts, beginning with 1864. It was found that the conditions which commonly prevailed during dry spells were—(1) high pressure over the British Isles, the greatest deviation from normal being usually over south-east England; (2) low pressure over the Arctic regions, especially near Spitsbergen; and (3) low pressure generally over the Tropics. The first factor was related to the eleven-year sunspot cycle, occurring most frequently two years after sunspot minimum and three or four years after sunspot maximum, so that it tended to recur every five or six years. Low pressure over the Arctic was related to ice conditions and tended to recur every four or five years. Great droughts only occurred when both these factors were favourable. With pressure low over the Arctic, two or three months' warning of a drought would be given by the development of high pressure over Northern Russia.

Professor T. Kobayasi (Imperial University of Tokio).—"On a Cyclone which crossed the Corean Peninsula, and the variations of its Polar Front." Professor Kobayasi has investigated how a cyclone passed over a mountain range in Corea on the

March 25th, 1918. The cyclone did not follow the usual process, which is for the top part to proceed across the mountain, leaving the bottom and extending itself to the surface on the other side of the mountain range; but it induced a secondary on the farther side of the range along the steering line. This secondary then extended upward until it joined with the primary at a certain height; then the secondary gradually grew stronger, when the original centre faded away and disappeared. The existence of the Polar Front was very distinctly marked, but was complicated in character. As secondaries were formed on the steering line, there were two or more squall lines for one steering line.

Correspondence.

To the Editors, Meteorological Magazine.

The Sun and the Weather.

MOST meteorologists are aware of the magnetic storm of May last year to which the Rev. A. L. Cortie refers;* but I do not think that such a storm, even though it be repeated with less intensity at each synodical rotation of the sun, can be regarded as dominating the conditions of the whole year. Although it is agreed that the year 1921 was, as compared with the average for the 35 years 1881–1915, a very dry one in the British Isles, the ratio to the average varied in the different months from 145 to 26 per cent.† and it is interesting to note that May had a rainfall only 9 per cent. less than the average. Father Cortie also says: "to judge from the horizontal component, the general magnetic field of the earth was more intense in 1921 than in 1920." Of course, the more intense the magnetic field of the earth the greater would be the proportion of electrons directed towards the poles; but this would appear to be a small factor as compared with the number of electrons shot out by the sun.

Sun-spots, when they occupy a certain position on the sun's surface as compared with the position of the earth, are potent causes of aurora and magnetic disturbances, but the chief factor seems to be the general condition of activity of the sun's equatorial belt.

R. M. DEELEY.

Tintagel, Kew Gardens Road, Kew, Surrey, January 25th, 1922.

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* *Meteorological Magazine*, Jan. 1922, Vol. 56, p. 358.
† *Ibid.*, p. 347.

The Effect of Vertical Currents on Gun-Ranging.

THE note by Mr. Britton in the last issue of the *Meteorological Magazine* (Vol. 56, p. 360) on the above subject is very interesting; but it is thought that the case as there presented is apt to give a slightly exaggerated idea of the effects produced by vertical currents.

In the first place, a shell will not be subjected to the same ascending currents as a pilot-balloon. It has been pointed out by Mr. J. S. Dines (*Advisory Committee for Aeronautics—Report No.* 47, pp. 18–19) that a pilot balloon tends to make its way into ascending rather than descending currents in the earliest stages of its ascent. If the heated air rises in the form of vortices or filaments, there will be a general flow of the surrounding air inwards towards the bottom of the rising air. Conversely, descending vortices or filaments will spread outwards near the ground and there will consequently be a flow of air away from the descending currents. It follows, therefore, that in the long run there will be a predominating tendency for pilot balloons to be carried away from descending currents and into ascending currents, and that two theodolite pilot-balloon ascents tend to exaggerate the frequency of ascending currents at the expense of the descending currents.

In the second place, it is important to remember that every ascending portion of air has its counterpart in an adjoining descending current. A pilot-balloon ascent tends to mask these descending currents; but they exist all the same, as is shown sometimes by a pilot-balloon, filled to rise at 500 feet per minute, rising less than 400 feet in the first minute, under conditions in which one knows that there is strong convection present. The descending currents are probably not so vigorous as the ascending, but they probably diminish appreciably the effect of the ascending currents.

It is therefore to be expected that if a pilot-balloon ascent indicates a mean standing velocity of the air of 5 feet per second up to the vertex of a trajectory, the over-ranging will be less than the calculated effect of a vertical wind velocity of this magnitude. For, in the first place, the pilot-balloon tends to select the strongest ascending currents, whereas the shell does not, and, in the second place, the shell is subject to descending currents, which a pilot-balloon avoids, but which tend to diminish the effect of the ascending currents upon the range.

Whilst, therefore, the effect of strong convection upon the shooting of a gun will be to decrease the accuracy of the shooting and to cause over-ranging, the increase in range will not be so great as it might appear to be at first sight.

Porton, January, 1922. NELSON K. JOHNSON.

Weather Lore.

THE following letter has reached me from Commander Brooke Smith :—

> "I have just seen your note "Weather Lore" in the February *Meteorological Magazine*. I quite believe that what the Captain of the *Jupiter* told you may often be correct.
>
> We often say at sea that weather changes when coming on soundings (*i.e.*, crossing the 100-fathom line), as, for example, when homeward bound, approaching Ushant.
>
> I have my own ideas about this, and if you examined the sea-surface temperatures to seaward and also on soundings, I think that you might perhaps be able to show us that sometimes these sayings are worth a good deal of consideration.
>
> If you could explain the physical causes in simple straightforward language, I feel sure the seafarers would benefit.
>
> In many estuaries where there are sand or mud flats we notice variations of wind with tide; the explanation seems simple in these cases, but I should not like to attempt to give one to anyone else but a sailor, as my language would be misunderstood.
>
> These are both questions which, if answered, would give us really useful information; for the latter, the Bristol Channel above Minehead might give you a good field."
>
> L. A. BROOKE SMITH.

Mrs. T. Story-Maskelyne writes from Basset Down, giving local variants of rhymes about February and Candlemas. It is more difficult on land to get the kind of local saw that I was referring to than it is at sea, because it involves that comparison of one place with another which comes within the experience of seamen as a matter of course, but not of landsmen unless they are carriers or railwaymen. The helm-wind is one of the well recognised local occurrences of the type I was thinking of. People living in Edinburgh are apt to think it a peculiarly windy place, and visitors might agree, but why should it be? Leith, I believe, is not.

NAPIER SHAW.

School of Meteorology, March 6th, 1922.

Distribution of Hoar Frost on Furrowed Grassland.

I NOTICED on Monday night, February 13th, a curious distribution of hoar frost on grass. I was crossing The Meadows, a large open space in Edinburgh, somewhat late in the evening. The path along which I was walking has grass on both sides of it, and the hoar frost, instead of being general over the grass, was in bands almost at right angles to the direction of the wind. On closer inspection it was seen that these bands of hoar frost were on the leeward slopes of small ridges or undulations. The wind at the time was from west-by-north, force about 3 or 4; so that on looking along the grass towards the east hardly any hoar frost was to be observed, while looking in the opposite direction irregular bands of hoar frost running mainly from north to south were distinctly noticeable. The night was a brilliant one, dry, with a temperature of about 30° F. Later in the night the air became much more humid and next morning the hoar frost was general and very heavy.

J. E. BELASCO.

Meteorological Office, Edinburgh, 16th February, 1922.

Units for Meteorological Work.

MAY I now make one or two remarks about the correspondence in the *Meteorological Magazine* on units of measurement? I read the letters carefully, including the "Case for Modern Units" by Mr. Whipple. The cases presented by barometrical readings and those for rainfall present such different conditions that they need separate consideration and treatment. Pressure records are complicated by corrections necessary for temperature latitude and height above sea-level. A good case can be made out, I consider, for the use of millibars, but rainfall measurement is simple; no corrections are required, and the use of millimetres, instead of simplifying, makes the records more obscure. Except for international comparison, which is comparatively unimportant in the case of rainfall, all the advantages appear to lie with the use of inches.

I venture to hope that the present dual system, which is annoying and confusing, will be terminated at an early date. For example, the frontispiece to *British Rainfall*, 1920, which must have involved great labour to prepare, is quite spoiled by this confusion. I turned from it at once with disgust.

I consider the adoption of the new unit will sadly handicap the value and popularity of rainfall observation.

S. F. HURNARD.

Hill House, Lexden, Colchester, January 11th, 1922.

NOTES AND QUERIES.

Ball Lightning.

AN interesting description of ball-lightning has been received from Captain J. H. W. Morgan, late of the Indian Army. In June, 1898, Captain Morgan and a friend were walking from Kailana in the North-west Himalayas towards Mussoorie. When they were at an elevation of 7,500 ft. they observed a violent monsoon thunderstorm driving up from the low country. Shortly after nightfall they reached Lakhwar, which is about 4,000 ft. up. The storm had passed over the district, although the lightning could still be seen in the distance, leaving dense masses of mist and cloud, while the air was very hot, still, and oppressive. In the dense mist a succession of pale, round lights were seen floating in the direction of the storm; each was watched till it was out of sight. The balls appeared about 6 ins. in diameter, but the edges were not well-defined. The colour was similar to that of a firefly, but the behaviour of the lights proved that they were not fireflies; moreover, no fireflies were found in the locality.

Another account of ball-lightning is given in *Nature* of January 26th by Mr. A. P. Chattock, of Bristol University. The ball was observed by the Misses Pitman at 8 p.m. on August 17th, 1921, at Eastbourne. The evening was still and not very hot, but heavy rain was falling. No thunder was heard, although a thunderstorm was reported from London at the same time. As one of the ladies took up a knife from the table a ball of light was seen to flash past it on to the table, when it disappeared with a spitting sound, leaving no mark or trace. The ball itself was about the size of a pea, and with the light encircling it about the size of a golf ball. In colour it was white, and intensely bright, and it travelled the nine inches from knife to cloth in a "flash of time."

A New Method of obtaining the Velocity of Upper Winds.

DURING the war, one of the most accurate methods of obtaining the upper wind at considerable heights consisted in watching, in a horizontal mirror, the smoke from a shell-burst. This method was itself an application of the ordinary reflecting nephoscope. The difference between a nephoscope observation and a shell-burst observation was that, in the latter case, the height of the shell-burst was known with considerable accuracy, whereas in the case of the cloud, the height could only be roughly guessed. The use of mirrors for

observations of shell bursts was extended by Colonel A. V. Hill, who introduced observations with two mirrors at the ends of a base line to determine the height as well as the horizontal motion. The mirrors used for this purpose are now commonly called Hill's Mirrors.*

It times of peace it is not permissible, in most places, to arrange shell-bursts. Consequently mirrors have gone out of fashion and upper winds are determined almost exclusively by means of pilot balloon observations. The pilot balloon method is likely to remain the standard for some time on account of its relative cheapness. The method, however, suffers from the disadvantage that observations at considerable heights are impracticable with high winds in the lower layers of the atmosphere, or with detached clouds.

Aeroplanes have recently been used for making smoke rings at considerable heights, and it occurred to me that smoke emitted from aeroplanes might be used instead of the smoke from as hell-burst, for observations of upper wind. An opportunity recently presented itself for the trial of the method, which proved successful. The experiments were made by Mr. C. D. Stewart. The "smoke" was produced by using a one-pound tin of Stannic Chloride. The tin has a wire soldered through the base and another to the lid. The wire through the base is fixed to the under-carriage of the aeroplane and the wire through the lid is passed up to the observer's seat. At a pre-determined height, the observer pulls the lid off the tin. The Stannic Chloride is quickly dispersed and a fine cloud produced which is easy to follow in the mirror. By using two or more tins, the wind at a series of pre-determined heights can be obtained quickly and accurately.

In practice the method can only be used when areoplanes are making ascents for other purposes, as it would usually be too expensive to employ an aeroplane specially for this purpose.

E. GOLD.

Frequency of Fog in the English Channel.

SOME information as to the frequency of fog at different parts of the coast may be gathered from the records kept by the keepers of lightships and lighthouses giving the hours during which the fog-syrens are sounded. The following summary is derived from statistics supplied by Trinity House to the

[* Hill's mirrors are illustrated in the second edition of *The Computer's Handbook*, Sec. II., p. 32. It is understood that the details of the apparatus were worked out by Colonel Hill in collaboration with Sir Horace Darwin.—ED. M. M.]

Meteorological Office and has been prepared in the Marine Division. It refers to the twelve years 1908, 1910–20.

Station.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Y.
	Percentage Duration in Hours.												
Longships - -	4·4	5·2	3·6	4·6	11·3	5·7	6·7	5·4	5·6	5·5	5·0	3·6	5·5
St. Catherine's Point	3·0	4·0	2·7	1·7	6·7	3·6	1·1	1·6	1·0	0·5	1·0	1·5	2·4

The "Longships" Light-vessel is stationed off the coast of Cornwall, 2 miles west of Land's End. St. Catherine's Point Lighthouse is on the Isle of Wight. It will be seen that the syren is used twice as frequently at the light-vessel. In both positions the sea-fog is most common in May.

A Tragedy of the Alps.

It is reported in the Press that the keeper of the meteorological observatory on Mount Saentis, and his wife, were found murdered on February 25th. The station is situated on the summit of the mountain, 8,215 feet above sea-level, in the Canton of Appenzell, south of Lake Constance. When the authorities failed to get an answer to telephone calls, it was thought that the lines had been broken down by the recent heavy snowfalls, and it was not until a porter visited the station with supplies that the crime was discovered.

The observations made at this station are among those distributed daily by wireless from the Eiffel Tower and they have proved of great use in the preparation of forecasts by the Meteorological Office.

The "Field" Forecasts.

The enterprise of the *Field* newspaper in publishing weather forecasts covering a week in advance has been the subject of much favourable comment during the past year. It is announced that subscribers are to receive in future a table which will cover twenty days in advance. The experiment will be watched with interest, even by the meteorologists who think that the methods which appear to be adopted are inadequate for the purpose.

Meteorological Stations.

Newport, Isle of Wight.—A climatological station has been set up by Mr. F. Morey of Wolverton, The Mall, Newport, and his observations are being published in the *Monthly Weather Report* as from January, 1922.

The Control of Lightning.

THE "lightning-rod man" has been long a familiar figure in American literature and certainly there has always been a wide scope for his activities. In Ontario alone, loss from fires caused by lightning has been estimated at something like half-a-million dollars a month. The lightning-rod man fell into disrepute, however, because he had not sufficient knowledge of lightning control and because his rods were not properly grounded and fixed. The Fire Prevention League of Ontario, realising the seriousness of this loss from fire, especially in agricultural and timbered districts, drafted a Lightning Rod Act which was passed by the Ontario Legislature to take effect on January 1st of this year. The Act provides for the use of standardised rods and gives detailed instruction as to their construction and installation. The League, which has been in existence since 1919, has already been successful in reducing substantially the annual loss from fire, and it is to be hoped that the Lightning Rod Act will prove effective in protecting homesteads and crops.

The Forecasting of Drought.

WRITING with reference to Mr. Brooks's article* entitled "Could the Drought of 1921 have been forecasted?" Mr. H. A. Rogers points out that such developments of meteorology would fulfil the hopes of Admiral Fitzroy, and would prove of the greatest benefit to agriculture and other industries. Mr. Rogers's experience as a meteorological observer goes back to 1856; he saw snow on the Mendips in June of that year, and was told that ice had come unusually far south in the Atlantic.

Standardized Rain Gauges.

MESSRS. CASELLA & CO. have issued a revised price list of rain gauges, and we are glad to see that the multiplicity of patterns which formerly confused the mind of the uninstructed purchaser has given way to a few well-designed and standardized types. One or two of those figured are unsuitable for general use, and a distinct step in the right direction is made by the insertion of a slip showing the gauges which are approved by the Meteorological Office. The statement that the "Dial gauge" is "accurate enough for the majority of private observers" is, however, one which we cannot endorse. No observer wishes to keep inaccurate records, and experience shows that after use for a year or two the indicators of dial gauges are seldom to be trusted.

* *Meteorological Magazine*, Sept. 1921, p. 211.

Eighteenth Century Meteorology.

THREE volumes of eighteenth-century meteorological records, in manuscript, have been lent to the Library of the Meteorological Office by the courtesy of the Provost and Fellows of Lancing College.

The first volume, by J. Whiston, gives elaborate descriptions of the weather at places in Worcestershire and Hereford for each day of 1703. The second, apparently by his grandson, gives general descriptions of the weather of each year from 1733 to 1794 at Lyndon, Rutland, while the third is a meteorological diary of observations from 1748 to 1763.

It is hoped that some enthusiast will be found to undertake the preparation of a summary of the records.

Philippine Folk-Lore.

THE New York *Literary Digest* of February 18th, 1922, contains a notice of Mr. Charles H. Meeker's work on the superstitions and folk-lore of the Philippines. Some of his collections have been published recently in the *Oklahoma County News*. The following sayings may be new to readers :—

"Bathing a cat causes rain."

"If you wish it to rain, put a lighted candle in a new pot, tie a string around the pot and pull it on the river like a small boat and a heavy rain will soon fall."

"Don't carry monkeys or cats with you on an ocean trip, because they will cause the wind to blow hard."

"When a sea-turtle comes ashore, it causes cool water."

Review.

Handbook of Meteorology: a Manual for Co-operative Observers and Students. By Jacques W. Redway. $8\frac{1}{2} \times 5\frac{1}{4}$. v + 294 pp. New York: Wiley and Sons. London: Chapman and Hall. 1921. 24*s*. net.

THE author of this handbook dates his preface from the Meteorological Laboratory, Mount Vernon, New York, and states that it is written "for the use of co-operative observers" and for the instruction of students in meteorology. Part I. contains a general account of the science, whilst Part II. deals with instruments and the standard methods of observation.

The general descriptive matter of Part I. is written in a popular way, hardly suitable, it might be thought, for the serious student. General principles are not clearly set out (for example, there is no explicit statement of Buys Ballot's Law), and algebra is taboo. There is only a single specimen of an isochronous

chart, though room is found for five pages of folklore. In passing, two samples of folklore may be quoted; a gruesome one—" When the locks turn damp in the scalp-house, most surely it will rain," and a " howler "—" A lunar halo indicates rain; the larger the halo the sooner may rain be expected."

The interest of the book to the English meteorologist is mainly in Part II., as the difference in equipment and practice as between English and American stations can be studied so readily. Take the thermometer screen,—our practice is to have the screen made with double louvres and to place it in an exposed position. Mr. Redway says that there can be no objection to placing the shelter in the shade of a tree, but on the other hand the front of his screen is apparently merely wire gauze. His advice is surely a counsel of perfection: " In locating a place for a shelter, it is a good plan to use a second thermometer in various positions, checking and comparing maxima and minima. Reflection and absorption sometimes bring about unexpected results. Observers with experience are alert to these possibilities; the inexperienced observer must learn them."

We are still accustomed to use dry and wet bulb thermometers without special ventilation. It is not clear from Mr. Redway's description how far the stationary hygrometer is used in America, but we learn that " the whirling table is now generally employed where systematic observations are made." Even with such apparatus, difficulties are not eliminated entirely, for " when the moisture is close to saturation two or three successive determinations may be necessary for a satisfactory result," and likewise when humidity is low the differences in several determinations " may be considerable."

As for the maximum thermometer the American observer is recommended to have the stem sloping with the bulb end uppermost, to avoid " retracting " of the column; the English observer has the stem sloping the other way to avoid the risk of the column running away from the constriction.

The American type of rain gauge which is provided with a narrow inner can has advantages. The quantity of rainfall is measured by dipping a stick in the can and seeing how far up it is wetted, and all risk of spilling any water in decanting it thereby avoided. Much is also to be learned from America as to the measurements of snow. Apparently accumulations of snow 30 feet thick have been gauged in the Sierra Nevada ranges.

Enough has been said to indicate that Mr. Redway's book is a valuable addition to our works of reference, even though it is not to be recommended to the English observer for everyday use.

News in Brief.

On March 8th a deep depression rapidly crossed southern England in a north-easterly direction, causing strong gales in the English Channel. A gust of 108 miles per hour was recorded at Scilly at 4 a.m. Only once before has a gust approaching this been reported to the Meteorological Office, viz., 110 miles per hour at Quilty, Co. Clare, on January 27th, 1920. The thermometer-screens at Cattewater, Pendennis Castle and Beachy Head were overthrown during the gale, and at Lympne Aerodrome an ex-army trailer used as an observation hut was blown 15 yards away and overturned.

Shoeburyness.—On Friday evening, January 6th, a Meteorological Office staff-dinner was held at Queen's Hotel, Westcliff-on-Sea. Mr. C. E. Britton was in the chair, and there were fourteen present, the guest of the evening being Capt. D. Brunt, Superintendent of the Army Services Division. It is hoped to make the dinner an annual institution.

The National Research Council at Washington have issued a Bulletin (Vol. 2, Part 7, No. 15) containing a list of the seismologic stations of the world, compiled by Mr. H. O. Wood.

The Times of January 25th states that an advertising toy-balloon sent up from Thrapston, Northants, during a recent shopping week, was picked up at Gussola, near Cremona, in Italy. It is hoped that further details will be obtained.

Mr. S. Single, of 17, Kensington Palace Mansions, S.W. 7, wishes to dispose of a Stevenson screen and a set of tested thermometers. Any reader wishing to purchase them should communicate with Mr. Single.

The Weather of February 1922.

The pressure distribution over the Atlantic, westward of Ireland, was almost continuously cyclonic throughout the month, whilst the Scandinavian regions and central Europe were largely dominated by anticyclonic conditions. Depressions were almost wholly confined to tracks northward, and north-eastward of the British Isles, with troughs of low pressure extending over our Islands. In western Europe and Iceland, temperature was generally high for the period of the year, but frost of exceptional severity prevailed over central Europe and round the Baltic, the state of the ice-bound sea restricting all shipping movements.

On the 1st a ridge of high pressure moving eastwards in the rear of a shallow low pressure trough was succeeded by a

depression which advanced quickly from the west. Warm air from the Atlantic temporarily displaced cold air from the Continent on the 2nd, sharp thunderstorms occurring over southern England during the afternoon. On the 4th a low pressure trough extended from Iceland to central Europe with south-easterly to easterly winds and a low temperature on its north-east edge, and westerly to north-westerly winds with relatively warm air on its south-west edge. The wedge of cold air advanced slowly westwards causing a day with continuous snow and sleet in eastern England, and with a maximum temperature of only 30° F. at Cranwell, Gorleston and Pulham. A thunderstorm occurred in the Channel Isles at 13 h. Precipitation over England varied between 3 and 5 mm., but Frankfort reported 34 mm., Zurich 17 mm. and Bayonne 21 mm. Conditions improved on the 5th, but temperature remained low over eastern England, with maxima around the freezing point and snow showers locally. Temperature was as high as 49° F. in Iceland, whilst Scandinavia, the Netherlands, and eastern Europe continued in the grip of severe frost. Hard frost occurred on the night of the 5th-6th, Benson reporting a shade minimum of 19° F., South Farnborough 16° F. (9° on grass), and Cranwell 15° F. (8° on grass), whilst −29° F. was experienced at Haparanda, and −13° F. at Saerna and Memel. Over Iceland a very deep depression was indicated with pressure below 964 mb. Low pressure was maintained from the Azores to Spitzbergen with comparatively mild conditions, the eastern half of Britain continuing under the influence of the cold continental air supply. Upper air temperatures on the 9th and 10th showed that the cold area was comparatively shallow. At Andover on the 9th there was an inversion of 10° F. at 1,000 feet, and on the 10th, of 15° F. at the same altitude. Up to 20,000 feet at Andover, South Farnborough and Leuchars (Fifeshire) there was an excess at all levels varying between 10° F. and 20° F. From the 10th to the 13th very bright weather was experienced over the southern districts, with daily sunshine records of between seven and eight hours. On the 12th a decided fall of pressure set in over western Europe, and with the establishment of a general southerly to south-westerly wind current, temperature rose. In the Netherlands and northern France the rise varied between 9° F. and 18° F. A centre of low pressure passed from Greenland to the south-east of Spitzbergen, high pressure at the Azores tending to spread north-eastwards. Associated with the passage of an anticyclonic ridge frost again occurred over the inland districts of England on the night of the 13th–14th, being quickly followed by the extension of an Atlantic "low" with rain and milder conditions on the succeeding day.

Cyclonic conditions became general over northern and western Europe, whilst an anticyclonic belt stretched from the Azores across Spain and Italy to southern Russia. On the 18th, in the rear of a secondary depression, which developed a definite centre over the northern part of the North Sea, a cold north-west wind-current set in with a marked temperature fall, a fine day with sunshine in excess of eight hours occurring over the southern districts. On the morning of the 19th, a depression of unusual depth was approaching rapidly from the Atlantic, pressure in the south of Iceland being down to the remarkably low level of 937 mb. The depression subsequently decreased in intensity, but remained almost stationary for several days in the Icelandic region, secondaries associated with it crossing the British Isles. Much hail, with sleet, snow and westerly gales were reported from the Atlantic, a temporarily colder air supply being in evidence on the western coasts. Thunderstorms or lightning, and hail occurred at the western seaboard stations on the 21st.

The Azores anticyclone subsequently advanced towards Spain, and a flow of warm air set in from the Azores region, becoming general over the British Isles on the 23rd. From the 23rd to the 25th maximum temperatures generally exceeded 55° F., reaching 60° F. in London and at Chester, 58° F. at Banff on the 24th, and 62° F. on the North-Wales coasts on the 25th. Secondary depressions maintained very variable weather to the close of the month, heavy falls of rain occurring in the western districts. At Valencia Observatory, 21 mm. fell on the 24th, and at Stornoway 18 mm. At Lerwick, Malin and Blacksod, 14 mm. were reported on the 25th, 20 mm. at Valencia. On the 27th, Lerwick again had 14 mm., and Scilly 22 mm. General but less heavy falls occurred further east with alternate bright and rainy days. Strong winds were general with gales in the English Channel, South Wales, and along the Atlantic seaboard, temperature continuing above the normal. From the 26th to the 28th thunderstorms, with local hail, were of daily occurrence at the western seaboard stations. Conditions in the Mediterranean area were mainly cyclonic throughout the month. Limassol reported a rainfall of 52 mm on the 4th. On the 6th, a deep depression occupied the region south-west of Italy and the spreading southward of the central-European anticyclone caused a steep gradient over northern Italy with a north-easterly gale at Pesaro on the 7th. Snow fell at Rome, and a temperature of 28° F. was reported from Florence on the morning of the 8th. Temperature was low at times on the north African coast.

Apart from much low cloud at times and local fog on the 1st and the 26th, visibility was mainly good to very good.

S. C. R.

A remarkable fall of temperature occurred over nearly the whole of France on the 5th. Thermometer readings as low as 10·4° F. at Paris and −5° F. at Strasbourg were recorded.

In the early part of the month central and southern Italy were suffering from continued cold weather. Snow fell in Rome on the morning of the 8th, an event which had not occurred for several years. The cold was severe and heavy snowfalls so widely distributed that telephonic communication was deranged all over the country, while railway traffic was delayed and in some parts entirely disorganised.

The severe cold brought packs of wolves down from the mountains along the Mediterranean coast of France and north Italy, and several villages have had to undertake protective measures. Numerous wolves have been seen on the outskirts of the town of Saint-Maximin, 25 miles inland from Toulon, an occurrence without precedent in living memory.

On the night of the 7th, 60° of frost were registered at St. Moritz and the weather has been very cold throughout Switzerland, with considerable snowfalls. An avalanche blocked the road and railway running by the shore of the Lake of Brienz on the 4th and extended 300 feet into the lake. The western part of Lake Neuchatel was covered with ice 8 inches thick at the middle of the month, and a week previously it was possible to walk from the island of Reichenau in the western part of Lake Constance to Constance, a distance of about four miles.

The whole of south-eastern Europe experienced a degree of cold such as has not been known for several years, and exceptionally heavy snowfalls occurred over Austria, Herzegovina, and Southern Hungary. Railway traffic was frequently blocked and on the 9th, the town of Sarajevo was completely isolated. Much suffering has been caused in Vienna. The Danube froze near Mohacz. In parts of Hungary the snowdrifts lay yards deep and trains and even small houses were completely buried.

In Christiania Fjord, the Cattegat and western Baltic generally, the ice has been so extensive that many ships were icebound off the coasts, in some cases for a fortnight or more. One ship had to be supplied with food by aeroplane. Towards the end of the month conditions were somewhat better, but large ice-breakers were still at work in Christiania Fjord where twenty steamers were held in the ice. On the 27th there was open water between Malmö and Copenhagen.

Several large ships suffered damage in the Atlantic early in the month, having encountered violent storms and gales.

On the 23rd, a great storm of sleet, rain and wind paralysed all transportation services depending on power from Niagara, and

(*Continued on* p. 60.)

Rainfall Table for February 1922.

STATION.	COUNTY.	Aver. 1881–1915.	1922.		Per cent. of Av.	Max. in 24 hrs.		No. of Rain Days
		in.	in.	mm.		in.	Date.	
Camden Square	*London*	1·67	2·20	56	132	·34	2, 21	15
Tenterden (View Tower)	*Kent*	1·97	2·20	56	112	·31	26	14
Arundel (Patching Farm)	*Sussex*	2·21	3·36	85	152	·64	27	16
Fordingbridge (Oaklands)	*Hampshire*	2·49	3·26	83	131	·44	2	21
Oxford (Magdalen College)	*Oxfordshire*	1·58	2·37	60	150	·35	27	16
Wellingborough (Swanspool)	*Northampton*	1·61	2·12	54	132	·42	28	16
Hawkedon Rectory	*Suffolk*	1·52	1·68	43	110	·44	2	13
Norwich (Eaton)	*Norfolk*	1·64	2·70	69	165	·80	3	14
Launceston (Polapit Tamar)	*Devon*	3·21	4·37	111	136	·64	28	18
Sidmouth (Sidmount)	"	2·50	2·60	66	104	·45	28	19
Ross (County Observatory)	*Herefordshire*	2·01	3·19	81	159	·81	28	19
Church Stretton (Wolstaston)	*Shropshire*	2·20	4·76	121	216	·85	27	17
Boston (Black Sluice)	*Lincoln*	1·46	2·46	63	168	·75	28	13
Worksop (Hodsock Priory)	*Nottingham*	1·54	2·65	67	172	·55	3	17
Mickleover (Clyd House)	*Derbyshire*	1·65	3·02	77	183	·61	28	16
Southport (Hesketh Park)	*Lancashire*	2·10	3·43	87	163	·70	2	18
Harrogate (Harlow Moor Ob.)	*York, W. R.*	2·09	3·28	83	157	·58	3	16
Hull (Pearson Park)	" *E. R.*	1·66	2·84	72	171	·55	2	18
Newcastle (Town Moor)	*North'land*	1·59	2·31	59	145	·59	3	13
Borrowdale (Seathwaite)	*Cumberland*	11·87	9·15	232	77	..	..	..
Cardiff (Ely Pumping Stn.)	*Glamorgan*	3·00	4·73	120	158	·77	27	20
Haverfordwest (Gram. Sch.)	*Pembroke*	3·48	5·07	129	146	·77	27	19
Aberystwyth (Gogerddan)	*Cardigan*	3·17	5·34	136	168	·75	27	15
Llandudno	*Carnarvon*	2·08	3·19	81	153	·55	3	16
Dumfries (Cargen)	*Kirkcudbrt.*	3·88	3·82	97	98	·59	2	22
Marchmont House	*Berwick*	2·08	2·96	75	142	·57	17	19
Girvan (Pinmore)	*Ayr*	4·27	4·90	125	115	·60	20	23
Glasgow (Queen's Park)	*Renfrew*	2·94	3·34	85	114	·45	2	21
Islay (Eallabus)	*Argyll*	4·19	7·17	182	171	·75	17	25
Mull (Quinish)	"	4·74	8·11	206	170	1·12	21	24
Loch Dhu	*Perth*	7·45	9·50	241	127	1·20	25	22
Dundee (Eastern Necropolis)	*Forfar*	1·88	2·47	63	131	·68	3	22
Braemar (Bank)	*Aberdeen*	2·85	3·15	80	111	·74	25	17
Aberdeen (Cranford)	"	2·32	2·41	61	104	·45	17	15
Gordon Castle	*Moray*	1·92	2·32	59	121	·69	17	16
Fort William (Atholl Bank)	*Inverness*	7·53	10·81	275	143	2·75	24	24
Alness (Ardross Castle)	*Ross*	3·30	4·00	102	121	·57	28	19
Loch Torridon (Bendamph)	"	7·90	11·95	303	151	2·20	24	23
Stornoway	"	4·46	5·36	136	120	·72	24	23
Loch More (Achfary)	*Sutherland*	6·60	6·05	154	92	·65	13	23
Wick	*Caithness*	2·27	1·79	46	79	·37	25	19
Glanmire (Lota Lodge)	*Cork*	3·95	4·40	112	111	·75	7	22
Killarney (District Asylum)	*Kerry*	5·22	7·44	199	143	·90	25	25
Waterford (Brook Lodge)	*Waterford*	3·26	3·00	76	92	·68	1	18
Nenagh (Castle Lough)	*Tipperary*	3·12	6·12	155	196	·73	3	23
Ennistymon House	*Clare*	3·40	6·28	159	185	·72	24	23
Gorey (Courtown House)	*Wexford*	2·81	2·01	51	72	·43	1	19
Abbey Leix (Blandsfort)	*Queen's Co.*	2·68	3·58	91	133	·64	2	20
Dublin (FitzWilliam Square)	*Dublin*	1·89	1·34	34	71	·16	3	17
Mullingar (Belvedere)	*Westmeath*	2·78	3·40	86	122	·53	2	21
Crossmolina (Enniscoe)	*Mayo*	4·46	7·27	185	163	·86	24	24
Collooney (Markree Obsy.)	*Sligo*	3·51	6·08	154	173	·84	24	23
Seaforde	*Down*	3·05	4·02	102	132	·59	1	21
Ballymena (Harryville)	*Antrim*	3·24	4·78	121	148	·81	3	23
Omagh (Edenfel)	*Tyrone*	2·98	5·49	139	184	·90	25	22
Letterkenny Asylum	*Donegal*	3·71	5·15	131	139	·78	24	24

Supplementary Rainfall, February 1922.

Div.	STATION.	RAIN.		Div.	STATION.	RAIN.	
		in.	mm.			in.	mm.
II.	Ramsgate	..	..	XII.	Langholm, Drove Rd.	5·68	144
,,	Sevenoaks, Speldhurst	2·64	67	XIII.	Ettrick Manse	5·95	151
,,	Hailsham Vicarage	2·63	67	,,	North Berwick Res.	2·12	54
,,	Totland Bay, Aston Ho.	2·36	60	,,	Edinburgh, Royal Ob.	1·86	47
,,	Ashley, Old Manor Ho.	2·82	72	XIV.	Biggar	3·13	79
,,	Grayshott	3·45	87	,,	Leadhills	8·48	215
,,	Ufton Nervet	2·71	69	,,	Kilmarnock, Agric. Coll.	5·13	130
III.	Harrow Weald, Hill Ho.	2·63	67	XV.	Dougarie Lodge	5·07	129
,,	Pitsford, Sedgebrook	2·08	53	,,	Oban	6·62	168
,,	Chatteris, The Priory.	1·56	40	,,	Holy Loch, Ardnadam	8·34	212
IV.	Elsenham, Gaunts End	1·93	49	,,	Tiree Cornaigmore	..	..
,,	Lexden, Hill House	1·66	42	XVI.	Loch Venachar	5·90	150
,,	Aylsham, Rippon Hall	2·90	74	,,	Glenquey Reservoir	3·80	97
,,	Swaffham	3·10	79	,,	Loch Rannoch, Dall	5·25	133
V.	Devizes, Highclere	3·05	77	,,	Blair Atholl	3·33	85
,,	Weymouth	2·72	69	,,	Coupar Angus	2·62	67
,,	Ashburton, Druid Ho.	7·30	185	,,	Montrose Asylum	2·12	54
,,	Cullompton	3·74	95	XVII.	Logie Coldstone, School	1·85	47
,,	Hartland Abbey	3·74	95	,,	Fyvie Castle	2·59	66
,,	Penzance, Morrab Gden.	4·70	119	,,	Grantown-on-Spey	1·92	49
,,	St. Austell, Trevarna.	4·49	114	XVIII.	Kingussie, Fasnakyle	3·04	77
,,	Crewkerne Merefield Ho	3·26	83	,,	Fort Augustus	6·20	157
VI.	Clifton College	3·81	97	,,	Loch Quoich, Loan	12·90	328
,,	Ledbury, Underdown.	2·67	68	,,	Fortrose	1·41	36
,,	Shifnal, Hatton Grange	2·56	65	,,	Faire-na-Squir	5·60	142
,,	Ashbourne, Mayfield.	3·19	81	,,	Skye, Dunvegan	7·82	199
,,	Barnt Green, Upwood	2·54	65	XIX.	Loch Carron, Plockton.	8·04	204
,,	Blockley, Upton Wold	3·39	86	,,	Dornoch, St. Gilbert's	2·04	52
VII.	Leicester, Town Hall Sq.	2·22	56	,,	Tongue Manse	1·65	42
,,	Grantham, Saltersford	2·63	67	XX.	Melvich Schoolhouse	2·20	56
,,	Louth, Westgate	3·00	76	,,	Dunmanway Rectory	8·10	206
,,	Mansfield, West Bank	2·89	73	,,	Mitchelstown Castle	4·33	110
VIII.	Nantwich, Dorfold Hall	2·83	72	,,	Gearahameen	12·70	323
,,	Bolton, Queen's Park.	4·13	105	,,	Darrynane Abbey	5·58	142
,,	Lancaster, Strathspey.	4·05	103	,,	Cashel, Ballinamona	3·75	91
IX.	Wath-upon-Dearne	2·39	61	,,	Roscrea, Timoney Pk.	3·44	87
,,	Bradford, Lister Park.	3·47	88	,,	Ballybunion	5·27	134
,,	West Witton	..	..	,,	Broadford, Hurdlesto'n	6·86	174
,,	Scarborough, Scalby	2·73	69	XXI.	Kilkenny Castle	2·48	63
,,	Middlesbro', Albert Pk.	1·54	39	,,	Rathnew, Clonmannon	1·83	47
,,	Mickleton	4·00	102	,,	Hacketstown Rectory	2·58	65
X.	Bellingham	3·58	91	,,	Balbriggan, Ardgillan	1·93	49
,,	Ilderton, Lilburn	2·32	59	,,	Drogheda	1·75	44
,,	Orton	5·80	147	,,	Athlone, Twyford	4·24	108
XI.	Llanfrechfa Grange	5·39	137	XXII.	Castle Forbes Gdns.	4·74	120
,,	Treherbert, Tyn-y-waun	13·89	353	,,	Ballynahinch Castle	8·03	204
,,	Carmarthen Friary	5·75	146	,,	Galway Grammar Sch.	5·19	132
,,	Lampeter, Falcondale	6·73	171	XXIII.	Westport House	5·59	142
,,	Cray Station	8·00	203	,,	Enniskillen, Portora	4·93	125
,,	B'ham W.W., Tyrmyndd	7·93	201	,,	Armagh Observatory	2·72	69
,,	Lake Vyrnwy	8·81	224	,,	Warrenpoint	3·15	80
,,	Llangynhafal, P. Drâw	2·99	76	,,	Belfast, Cave Hill Rd.	4·23	107
,,	Oakley Quarries	12·39	315	,,	Glenarm Castle	4·75	121
,,	Dolgelly, Bryntirion	7·14	181	,,	Londonderry, Creggan.	4·92	125
,,	Snowdon, L. Llydaw.	16·90	429	,,	Sion Mills	4·72	120
,,	Lligwy	3·73	95	,,	Milford, The Manse	5·19	132
XII.	Stoneykirk, Ardwell Ho.	4·72	120	,,	Narin, Kiltoorish	6·03	153
,,	Carsphairn, Shiel	7·97	202	,,	Killybegs, Rockmount	7·40	188

Climatological Table for the British

STATIONS	PRESSURE		TEMPERATURE							
			Absolute				Mean Values			
	Mean M.S.L.	Diff. from Normal	Max.	Date	Min.	Date	Max.	Min.	½ max. and min.	Diff. from Normal
	mb.	mb.	°F.		°F.		°F.	°F.	°F.	°F.
London, Kew Observatory	1020·3	+3·5	82	8	39	29	69·3	50·2	59·8	+2·7
Gibraltar	1016·0	+0·2	84	5	60	24	78·1	66·0	72·1	−0·5
Malta	1017·1	+1·4	86	22	61	29, 30	81·3	72·3	76·8	+1·5
Sierra Leone	1012·8	+0·2	88	23, 26	71	16, 24, 30	84·4	73·2	78·8	−0·3
Lagos, Nigeria	1013·8	+1·0	87	29	71	5	83·0	74·3	78·7	+0·6
Kaduna, Nigeria	1013·8	+1·0	89	27, 28, 30	62	27	83·7	66·3	75·0	−1·8
Zomba, Nyasaland	1015·4	+1·6	87	29	51	16, 17	79·5	59·3	69·4	+0·3
Salisbury, Rhodesia	1014·5	−0·2	90	25	43	15	80·9	50·6	65·7	−0·5
Cape Town	1020·4	+1·3	83	12	39	3	65·2	49·0	57·1	−0·8
Johannesburg	1019·3	+1·5	83	29	32	10	69·6	47·3	58·5	−0·8
Mauritius	..	..	..	..	..	..	..	..	..	..
Bloemfontein	..	..	83	29	31	26	72·6	43·3	57·9	−1·2
Calcutta, Alipore Obsy.	1004·0	−0·5	91	8	74	26	88·2	78·6	83·4	+0·4
Bombay	1007·6	−0·4	86	30	74	16	84·0	76·6	80·3	−0·4
Madras	1006·8	+0·3	99	23	73	11	93·1	77·3	85·2	+0·1
Colombo, Ceylon	1010·8	+1·2	89	16	75	2	87·1	77·8	82·5	+1·1
Hong Kong	1009·4	+1·1	91	19	71	24	84·4	76·8	80·6	−0·4
Sandakan	..	..	91	24	71	13	87·7	74·6	81·1	−0·6
Sydney	1018·2	+2·2	84	26	44	1	71·6	52·8	62·2	+3·2
Melbourne	..	..	..	..	..	..	..	..	..	..
Adelaide	1016·5	−1·0	82	28	42	20	68·6	50·3	59·5	+2·5
Perth, Western Australia	1019·0	+1·2	77	3	41	9	65·5	49·2	57·3	−0·9
Coolgardie	1017·3	+0·2	83	4	36	9	72·5	45·7	59·1	+0·5
Brisbane	1019·9	+2·8	80	17	49	21	74·0	56·9	65·5	+0·2
Hobart, Tasmania	1010·8	+0·1	77	7	37	22	62·5	45·8	54·1	+3·3
Wellington, N.Z.	1018·7	+5·2	68	29	31	1	58·5	46·0	52·3	+0·8
Suva, Fiji	1016·4	+2·1	85	22	59	3	83·9	65·2	74·5	0·0
Kingston, Jamaica	1012·9	+0·3	93	7	70	23	89·8	72·4	81·1	−0·4
Grenada, W.I.	1009·5	−2·3	93	7	71	9	86·0	75·3	80·7	+0·5
Toronto	1014·9	−2·6	92	2	43	27	79	57	68	+9
Winnipeg	1009·6	−5·2	91	1	36	30	66	48	57	+3·5
St. John, N.B.	1014·9	−2·6	87	3	38	21	66	50	58	+2
Victoria, B.C.	1016·9	+0·4	69	5, 10	42	29	61	48	54·5	−1

LONDON, KEW OBSERVATORY.—Mean speed of wind 5·7 mi/hr; 1 day with thunder heard, 7 days with fog.

GIBRALTAR.—2 days with thunder heard. From this month mean max. temp. refers to the period 7h. to 21h. and mean min. temp. 21h. to 7h.

MALTA.—Wind direction variable; 2 days with thunder heard.

SIERRA LEONE.—Prevailing wind direction SW; 6 days with thunder heard.

MADRAS.—6 days with thunder heard.

British Empire, September 1921.

TEMPERATURE		Relative Humidity	Mean Cloud Am'nt	PRECIPITATION				BRIGHT SUNSHINE		STATIONS
Mean	Absolute			Amount		Diff. from Normal	Days	Hours per day	Percentage of possible	
Wet Bulb.	Min. on Grass									
°F.	°F.	%	0–10	in.	mm.	mm.				
55·8	32	70	5·2	1·76	45	− 3	4	5·5	43	London, Kew Observatory
68·6	46	86	4·6	0·28	7	− 29	5	..	..	Gibraltar.
71·9	54	73	3·6	1·29	33	+ 3	4	8·7	70	Malta.
74·7	..	80	7·3	23·35	593	−134	25	..	..	Sierra Leone.
74·4	70	85	9·4	7·94	202	+ 72	16	..	..	Lagos, Nigeria.
69·8	..	86	..	15·28	388	+128	22	..	..	Kaduna, Nigeria.
..	..	89	3·2	0·87	22	+ 13	5	..	..	Zomba, Nyasaland.
54·3	40	45	1·9	0·00	0	− 8	0	..	..	Salisbury, Rhodesia.
53·4	..	70	5·3	2·88	73	+ 16	8	..	..	Cape Town.
46·2	33	53	2·1	1·67	42	+ 18	4	9·5	80	Johannesburg.
..	..	..	..	..	..	..	..	..	..	Mauritius.
47·1	..	53	2·1	0·60	15	− 8	2	..	..	Bloemfontein.
79·7	72	76	8·2	6·35	161	−102	16*	..	..	Calcutta, Alipore Obsy.
76·0	70	80	6·6	13·13	334	+ 59	26*	..	..	Bombay.
76·0	..	75	5·7	2·54	65	− 66	9*	..	..	Madras.
77·2	72	68	7·6	0·94	24	−102	7	..	..	Colombo, Ceylon.
74·3	..	75	6·7	12·10	307	+ 61	12	6·7	55	Hong Kong.
76·2	..	81	..	6·68	170	− 69	18	..	..	Sandakan.
57·5	37	63	3·9	2·82	72	− 2	8	7·5	65	Sydney.
..	..	..	..	..	..	..	..	..	..	Melbourne.
53·0	33	62	4·8	3·07	78	+ 28	14	6·9	59	Adelaide.
54·4	32	70	5·3	5·34	136	+ 51	16	6·5	55	Perth, Western Australia.
51·9	33	42	3·3	0·57	14	− 1	5	..	..	Coolgardie.
61·3	44	69	4·5	2·02	51	− 2	15	..	..	Brisbane.
47·8	29	61	6·2	0·96	24	− 30	14	6·1	52	Hobart, Tasmania.
48·4	26	75	5·9	5·76	146	+ 47	10	6·4	54	Wellington, N.Z.
73·3	..	96	..	10·03	255	+ 78	22	..	..	Suva, Fiji.
..	..	80	6·5	5·11	130	+ 26	13	..	..	Kingston, Jamaica.
76·7	..	75	4·1	9·80	249	+ 44	19	..	..	Grenada, W.I.
59·9	38	77	4·3	1·27	32	− 49	9	..	..	Toronto.
52·9	..	94	5·7	3·63	92	+ 42	14	..	..	Winnipeg.
53·7	32	81	5·0	3·79	96	+ 1	10	..	..	St. John, N.B.
50·4	35	78	5·6	2·80	71	+ 20	14	..	..	Victoria, B.C.

* For Indian stations a rain day is a day on which 0·1 in. (2·5 mm.) or more rain has fallen.

COLOMBO, CEYLON.—Prevailing wind direction WSW, mean speed 7·0 mi/hr.

HONG KONG.—Prevailing wind direction E, mean speed 11·3 mi/hr; 6 days with thunder heard.

PERTH, W. AUSTRALIA.—Pressure on 16th lowest on record for September (996·9 mb.).

WELLINGTON, N.Z.—1 day with hail.

GRENADA, W.I.—Prevailing wind direction ESE; 2 days with thunder heard. Severe gale passed over the island on 8th.

(*Continued from* p. 55.)

street-car and other communications were suspended in Toronto and other western cities for six hours.

Famine has resulted in certain districts of Kenya (British East Africa) as a result of the general failure of the rains for the past nine months.

The special message from Brazil states that in the north, rainfall was generally scarce, being 69 mm. below normal. In the central district, rainfall was well distributed over the coast and interior, with 47 mm. above normal; but in the south it was very irregular. The temperature of the month was above normal in most places and thunderstorms were unusually frequent between Pernambuco and Rio. The coffee crop has improved considerably, but the crops of cane, tobacco and cotton are not satisfactory.

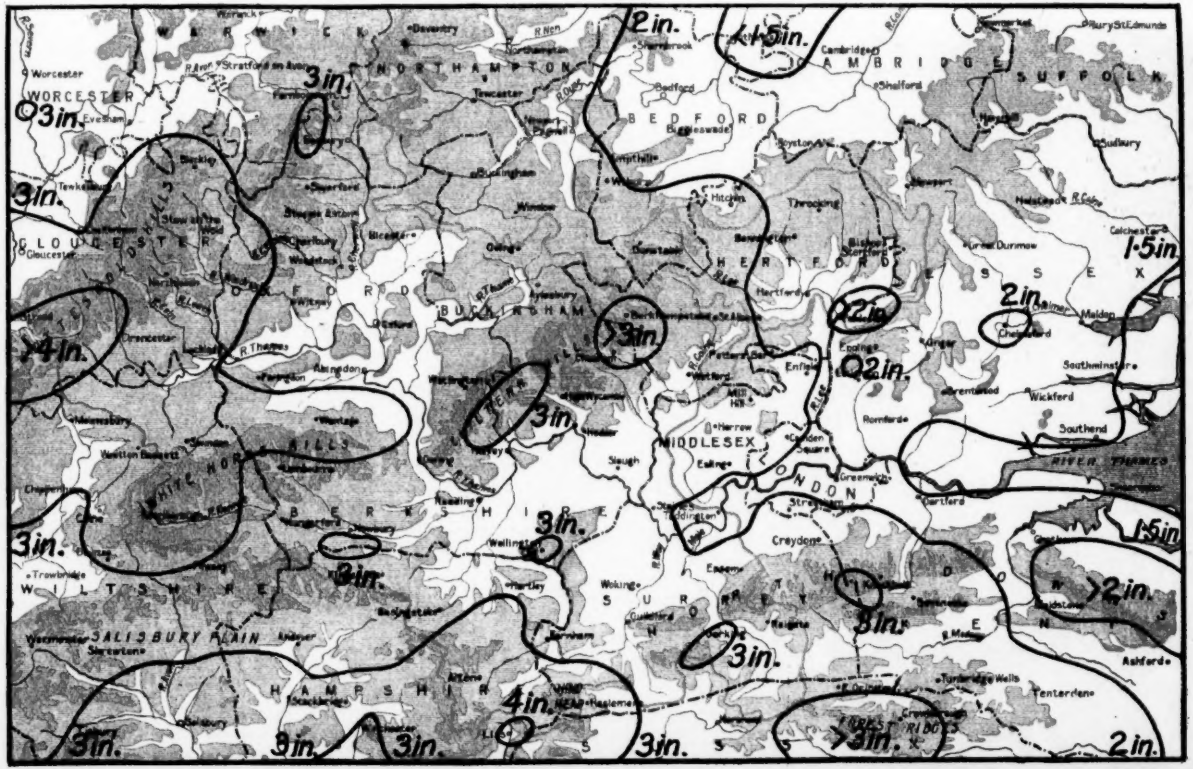
A letter from Mr. R. C. Mossman states that in the Argentine the chief feature of the early days of the month was an anticyclone which appeared from the Pacific on the 9th and caused a severe frost in the Pampas region. Fortunately no damage was done to crops.

THE rainfall of February was above the average nearly everywhere in the British Isles. Less than the average of the period 1881–1915 occurred in the neighbourhood of the English Lake District, the extreme north of Scotland and the south-east of Ireland. The areas with more than 150 per cent. of the average were very widespread, occupying practically the whole of Wales, central England, the north-western half of Ireland and the extreme west of Scotland. More than twice the average occurred in the neighbourhood of Shropshire. Everywhere in the British Isles the rainfall for the month appears to have exceeded 25 mm. (1 in.); less than 50 mm. ·(2 in.) falling in the south-east of England and locally along the extreme east coasts of England, Scotland and Ireland. More than 250 mm. (10 in.) fell in the mountainous areas, but generally the areas were small. As much as 500 mm. (20 in.) fell on Snowdon. Following on the heavy rain in eastern Scotland during January, the heavy rain towards the end of February, accompanied by the melting of snow on the surrounding hills, caused considerable damage by flooding, especially in the valleys of the Tay and Dee. At Perth the flood was the severest experienced for several years.

The general rainfall for the countries, expressed as a percentage of the average, was: England and Wales, 148; Scotland, 124; Ireland, 138; British Isles, 138.

In London (Camden Square), the mean temperature was 41·0° F., or 1·1° F. above the average; the duration of rainfall, 45·4 hours, and the evaporation, ·31 in.

THAMES VALLEY RAINFALL —— FEBRUARY, 1922.



H.M. Stationery Office Press, Kingsway, W.C.2.

Pc 933/1922 Pt. M.O. 214 (250) 9/22.